Anatomical and functional study of the air-sacs of birds by injection of polymers

Final degree project by Xavier Fernandez Georges. June 2019

INTRODUCTION: In 1651 William Harvey described air sacs in birds, since then much progress has been made but there are still problems to understand. Nowadays birds air-sacs are still a mistery in some points.

OBJECTIVES

-To explore different commercial materials in order to obtain good quality anatomical casts.

-Inject and polymerize the material in the respiratory system and thereafter remove the organic tissue to obtain the casts of the air sacs and lungs that allow to understand the connection among them.

MATERIAL AND METHODS:

Birds:

Columba livia

Pica pica

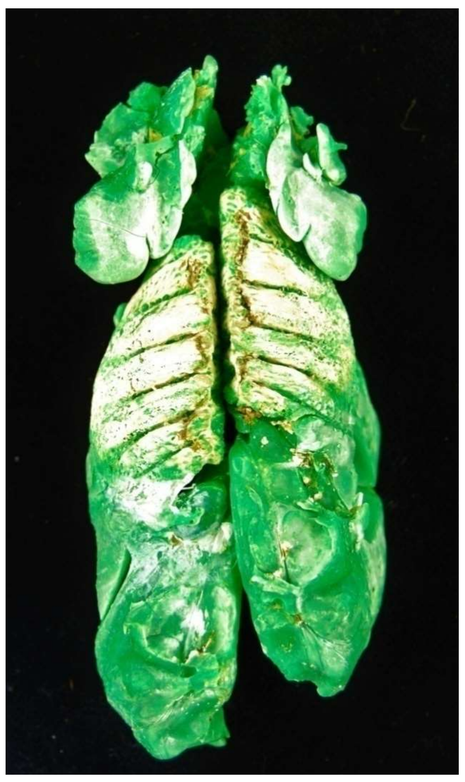
Gallus domesticus

Polymers: Poliester resin, epoxy resin, silicone, polyurethane resin and latex

Injection of the resin through the trachea
Polymerization of the resin overnight
Removal of organic tissue by boiling with sodium hypochlorite

RESULTS:

Poliester Resin



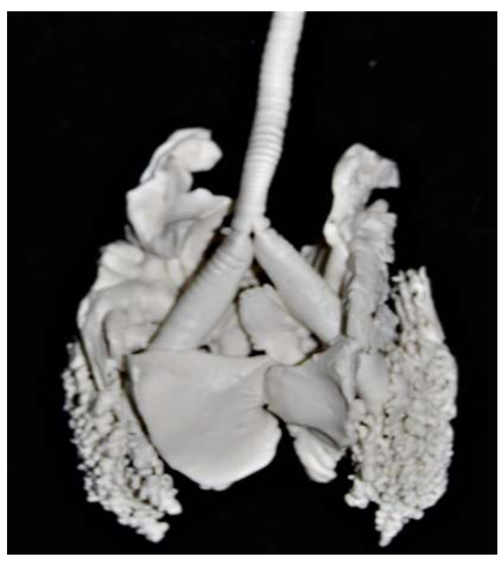
Pigeon air sacs and lungs. Dorsal and ventral views

Broiler air sacs and lungs. Dorsal view

Epoxy Resin

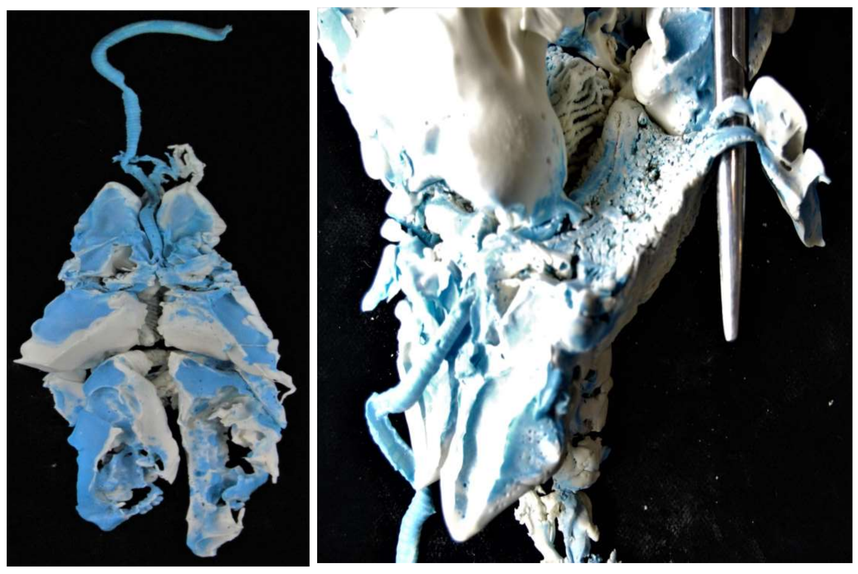
Broiler air sacs and lungs. Dorsal and ventral views

Silicone



Broiler air sacs and lungs. Dorsal and ventral views

Magpie air sacs and lungs. Ventral view



Broiler air sacs and lungs. Ventral view and detail of the double connection

CONCLUSIONS

1) Polyester and epoxy resins and silicone are very useful in order to obtain air sac casts in birds.
2) The casts obtained were very detailed and allowed a good morphological study.
3) Casts made from polyester and epoxy resins were rigid, while silicone casts were very flexible and allowed access to the internal faces of the structures.
4) It seems, at least *post mortem*, that there is no valve mechanism in the airways of birds, acting as a single cavity. This does not exclude the possibility of sphincter mechanisms.
5) In the air sacs of the broilers there seems to be a volumetric predominance of the caudal air sacs, while in pigeon and magpie, flying birds, the volumes of cranial and caudal air sacs are more balanced.
6) In the cranial and caudal thoracic air sacs there are two connections with the lungs that in vivo, could be incoming and outgoing airways.